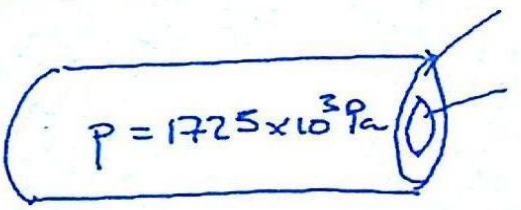
Example 1.



Find σ_L
σ_h

$\therefore$ Hoop Stress

$$\sigma_h = \frac{p \cdot d}{2t}$$

$$\therefore \sigma_h = \frac{(1725 \times 10^3)(1.5)}{(2)(13 \times 10^{-3})}$$

$$\sigma_h = 99.51 \times 10^6 \ N/m^2$$

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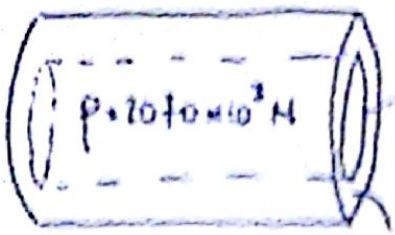
Ex 2



Given:

Tensile Strength of Steel plate : 420×10^6 N/m²

S.F = 4

joint efficiency η = 70% = 0.7

To find min plate thickness:

N.B. Tensile Strength = $\sigma_{max} = 420 \times 10^6$ N/m²

also, S.F = $\frac{\sigma_{max}}{\sigma_{work}}$ Here, σ_w = working stress.

σ_w

$\Rightarrow \sigma_w = \frac{\sigma_{max}}{S.F}$

Power law

(η σ_w for safety).

$\therefore \sigma_w = \frac{\sigma_{max}}{S.F}$ (1)

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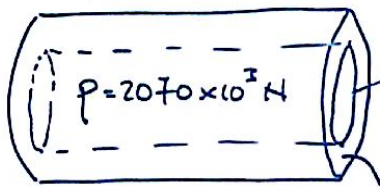
Ex 2



Given:

Tensile Strength of Steel plate = 620×10^6 N/m²

S.F = 4.

joint efficiencies η = 70% = 0.7

To find min plate thickness.

N.B. Tensile Strength ≡ $\sigma_{max.}$ = 620×10^6 N/m²

also, $S.F = \frac{\sigma_{max}}{\sigma_{work.}}$ Here, σ_h = largest = working stress.

$\Rightarrow \sigma_w = \frac{\sigma_{max}}{S.F}$

Remember $\eta . \sigma_h$ For weakly.

$\therefore \sigma_h = \frac{\sigma_{max}}{S.F}$ ①

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N.B.- Here, we are given a joint efficiency $\eta = 0.7$

$\Rightarrow$ we adjust eq^{n} (1) as follows:

$$\eta . \sigma_h = \frac{\sigma_{max}}{SF}$$

$$\sigma_h = \frac{\sigma_{max}}{\eta . SF} = \frac{(620 \times 10^6)}{(0.7)(4)}$$

$$\therefore \sigma_h = 221.42 \times 10^6$$

But $\sigma_h = \frac{P.d}{2t}$ $\therefore \frac{P.d}{2t} = 221.42 \times 10^6$

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N.B - Here, we are given a joint efficiency $\eta = 0.7$

$\Rightarrow$ we adjust eq^{n} (1) as follows:

$$\eta \cdot \sigma_h = \frac{\sigma_{max}}{SF}$$

$$\sigma_h = \frac{\sigma_{max}}{\eta \cdot SF} = \frac{(620 \times 10^6)}{(0.7)(4)}$$

$$\therefore \sigma_h = 221.42 \times 10^6$$

But $\sigma_h = \frac{P \cdot d}{2t}$ $\therefore \frac{P \cdot d}{2t} = 221.42 \times 10^6$

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$$\frac{pd}{2t} = 221.42 \times 10^6$$

$$\therefore \quad t = \frac{p \cdot d}{2(221.42 \times 10^6)}$$

$$t = \frac{[(2070 \times 10^3) \cdot (2.44)]}{[(2)(221.42 \times 10^6)]}$$

$$\therefore t = 11.41 \times 10^{-3} \text{ m}.$$

$\therefore$ min thickness of vessel = 11.41 mm

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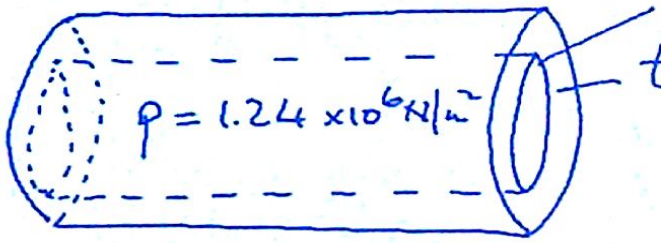
Example 3.



Given.

$\sigma_{max} = 460 \times 10^6\,N/m^2$

Longitudinal $\eta_L = 0.75$

hoop $\eta_h = 0.5$

Find S.F

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$S.F = \frac{\sigma_{max}}{\sigma_{wall}}$. ∴ Hence $\boxed{SF = \frac{\sigma_{max}}{\sigma_h}}$ — (1)

Here σ_h is affected by Longitudinal joint.

$\therefore \sigma_h \longrightarrow \eta_L . \sigma_h$

∴ Hoop stress $\sigma_h = \frac{p.d}{2t} = \frac{[(1.24 \times 10^6).(1.83)]}{[(2)(13 \times 10^{-3})]}$

$\therefore \sigma_h = 87.28 \times 10^6$ N/m²

∴ From (1)

$SF = \frac{\sigma_{max}}{\eta_L . \sigma_h} \Rightarrow \left[\frac{(460 \times 10^6)}{(0.75).(87.28 \times 10^6)}\right]$

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$\therefore$ SF = 7.02 [check. as it is twice as large]

? too Big.

Check: $SF = \frac{\sigma_{max}}{\sigma_{work.}}$

$\sigma_w = \sigma_h$

$\sigma_w = \frac{p \cdot d}{2t}$

$\eta_L \cdot \sigma_h = \frac{p \cdot d}{2t}$

$\therefore \sigma_h = \frac{p \cdot d}{\eta_L \cdot 2t}$

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$S.F = \frac{\sigma_{max}}{\sigma_{work.}}$ ∴ Here $SF = \frac{\sigma_{max}}{\sigma_h}$? (1)

$$\therefore \sigma_h = \frac{\{(1.24\times10^6)(1.83)\}}{((0.75)(2)(13\times10^{-3})\}}$$

$$\sigma_h = 116.37\times10^6.$$

$$\therefore SF = \frac{(460\times10^6)}{(116.37\times10^6)}$$

$SF = 3.95$ = Required Safety Factor.

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$\therefore$ $SF = 7.02$ [check. as it is twice as large]

? too Big.

Check:

$$SF = \frac{\sigma_{max}}{\sigma_{work.}}$$

$\sigma_w = \sigma_h$

$\frac{p.d}{2t}$

$\sigma_w = \sigma_h \cdot \eta_L \sigma_h = \frac{p.d}{2t}$

N.B. $\therefore \sigma_h = \frac{p.d}{\eta_L . 2t}$

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